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Principles for Conducting Critical Realist Case Study Research in Information Systems

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PRINCIPLES FOR CONDUCTING CRITICAL REALIST CASE STUDY RESEARCH IN INFORMATION SYSTEMS[1]

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Critical realism is emerging as a viable philosophical paradigm for conducting social science research, and has been proposed as an alternative to the more prevalent paradigms of positivism and interpretivism. Few papers, however, have offered clear guidance for applying this philosophy to actual research methodologies. Under critical realism, a causal explanation for a given phenomenon is inferred by explicitly identifying the means by which structural entities and contextual conditions interact to generate a given set of events. Consistent with this view of causality, we propose a set of methodological principles for conducting and evaluating critical realism-based explanatory case study research within the information systems field. The principles are derived directly from the ontological and epistemological assumptions of critical realism. We demonstrate the utility of each of the principles through examples drawn from existing critical realist case studies. The article concludes by discussing the implications of critical realism based research for IS research and practice.

Keywords: Critical realism, case study research, methodology, philosophy, causal explanation

Introduction

Critical realism (CR) is becoming recognized as a viable philosophical paradigm for conducting social science research. CR-based research methodologies offer researchers new opportunities to investigate complex organizational phenomena in a holistic manner. CR-based research can effectively respond to recent calls for improved theorizing and creating IS theories that are systems-oriented (Lee 2004) and that identify the mechanisms which connect "chains of indeterminate events and complex interactions" (Grover et al. 2008, p. 45). This allows researchers to develop and support in-depth causal explanations for the outcomes of specific sociotechnical phenomena that take into account the breadth of information technology, social, organizational, and environmental factors which may have played a causal role in their occurrence. Approaches adopting this paradigm are "very useful in teasing out what role (if any) IT plays in observed IT uses and consequences" (Markus and Silver 2008, p. 613).

As formulated by Bhaskar (1975, 1998) and extended by others, modern critical realism is positioned as an alternative to the positivist and interpretivist paradigms, and leverages elements of both to provide new approaches to developing knowledge. Specifically, critical realism acknowledges the role of subjective knowledge of social actors in a given situation as well as the existence of independent structures

[1]Juhani Iivari was the accepting senior editor for this paper. Robert Johnston served as the associate editor.

that constrain and enable these actors to pursue certain actions in a particular setting. Thus, theorists and researchers applying methodological approaches consistent with the CR paradigm are positioned to provide more detailed causal explanations of a given set of phenomena or events in terms of both the actors' interpretations and the structures and mechanisms that interact to produce the outcomes in question. This paradigm has been proposed as a means by which researchers can transcend a number of inconsistencies between the stated philosophical assumptions and the actual practice of IS research under both positivism and interpretivism (Smith 2006). As such, CR also offers a way to address the rigor–relevance gap in management research because of its multimethod and multilevel approaches to causal analysis (Hodgkinson and Rousseau 2009; Syed et al. 2009) and because of the potential to draw clearer links between the implementation of specific IS technologies and their outcomes (Straub and Ang 2008).

The extant CR-based literature represents a variety of social science disciplines including sociology (Pawson and Tilley 1997; Steinmetz 1998) and economics (Downward et al. 2002; Lawson 1997), as well as business disciplines such as management (Fleetwood and Ackroyd 2002; Tsoukas 1989) and marketing (Hunt 1990; Sobh and Perry 2006; Zinkhan and Hirschheim 1992). Within IS, a number of researchers have endeavored to describe the philosophical foundations of critical realism and called for more CR-based studies (Carlsson 2004; Dobson 2001; Dobson et al. 2007; Mingers 2004b; Smith 2006) or discussed the theoretical implications of CR (Mutch 2002, 2010), while a limited few have recently published empirical studies (de Vaujany 2008; Kirsch 2004; Morton 2006; Mutch 2002, 2010; Volkoff et al. 2007; Zachariadis et al. 2010) using CR as an underlying philosophy.

Despite these calls for more empirical research adopting the CR paradigm, researchers are challenged to find tangible recommendations in the literature for how to do this type of research. There are a limited number of examples in other social science disciplines (Danermark et al. 2002; Layder 1990; Sayer 1992; Yeung 1997) but few within IS or organization sciences. As a result, researchers seeking to employ CR often find it necessary to review and integrate a large body of abstract philosophical literature in order to produce research consistent with its ontological and epistemological assumptions.

This article offers a set of methodological principles for conducting and evaluating CR-based case study research in IS. While critical realism can accommodate a variety of methodological choices, we focus on the conduct of case study research as the methodology that is perhaps best suited for critical realist studies seeking to develop causal explanations of complex events (Dobson 2001; Easton 2010; Easton and Harrison 2004). In so doing, we follow other researchers in the positivist (Benbasat et al. 1987; Dubé and Paré 2003; Lee 1989) and interpretivist (Klein and Myers 1999; Walsham 1995) traditions in developing the philosophical assumptions behind the critical realist paradigm into an actionable approach for conducting case study research in IS.

The article proceeds as follows. First, the philosophical paradigm of critical realism is discussed, in particular the central role of causality in CR and how this differs from positivism and interpretivism. Next, the core ontological assumptions of CR are explicated, followed by a review of the epistemological tenets of critical realism and how these are derived from and intertwined with its ontological assumptions. We then propose a set of five methodological principles for conducting and evaluating case study research from a critical realist perspective. These principles are derived from both the ontological and epistemological assumptions of CR. We then discuss three aspects of case study research that have specific manifestations in critical realism. To illustrate the meaning and utility of these principles, we highlight how they are manifest in several articles in the IS literature that adapted the CR philosophy to case study research. We conclude with a discussion of contributions of CR and adapting these principles to the conduct of IS case study research.

Philosophical Paradigms and Critical Realism: Focus on Causality

In the conduct of scientific research, the actions of researchers are guided by the systems of belief by which they generate and interpret knowledge claims about reality (Chua 1986; Myers 2009). These systems of belief, or paradigms (Guba 1990), can be defined by their answers to three sets of questions involving ontology, epistemology, and methodology. Ontology refers to assumptions about the nature of reality; epistemology refers to the evidentiary assessment and justification of knowledge claims; and methodology is concerned with the process or procedures by which we create these knowledge claims (Chua 1986; Guba 1990; Orlikowski and Baroudi 1991).

Mainstream research in IS has been conducted primarily under two philosophical paradigms: positivism and interpretivism. Positivism is largely concerned with the testing, confirmation and falsification, and predictive ability of generalizable theories about an objective, readily apprehended reality (Chua 1986; Orlikowski and Baroudi 1991). Inter-

pretivism instead focuses on understanding the subjective meanings that participants assign to a given phenomena within a specific, unique context (Klein and Myers 1999; Orlikowski and Baroudi 1991; Walsham 1993).

In recent years, critical realism has garnered increasing interest among researchers in various social science disciplines. The foundation for this growing interest is the philosophy originated and espoused by Roy Bhaskar, who introduced his transcendental realist philosophy for the natural sciences in *A Realist Theory of Science* (Bhaskar 1975) and then extended it to the social sciences in *The Possibility of Naturalism* (Bhaskar 1998). The basic concepts have been explained, refined, and extended by a number of authors, many of whom have been cited by Bhaskar for their contributions to his work (e.g., Archer 1995; Collier 1994; Danermark et al. 2002; Lawson 1997; Layder 1993; Mingers 2006; Outhwaite 1987; Sayer 1992). While Bhaskar has written extensively expanding his views on the philosophy of critical realism, we focus here on the foundational concepts originally presented in the seminal works listed above (Bhaskar 1975, 1998). These early works explicate the essential elements of the paradigm directly related to deriving causal explanations of social phenomenon without introducing the complexities of other philosophical, metaphysical, and axiological issues that have concerned Bhaskar in his later writings (1986, 1993, 1994, 2000).

Contemporary CR assumes that the theories generated by the conduct of scientific research must revolve around the independent reality that comprises the world, even though humans are usually unable to fully understand or observe this reality, and that our knowledge of reality is fallible. Bhaskar (1998, p. 176) agreed with the description of CR as "ontologically bold but epistemologically cautious" (Outhwaite 1987, p. 34). The specific form of this reality within CR consists of structures, along with the powers or tendencies inherent to the components of these structures, and the interactions between them. As such, CR-based research focuses on answering the question of what the components and interactions within this reality must be like in order to explain the occurrence of a given set of events (Bhaskar 1975).

The paradigmatic assumptions of CR differ in a number of fundamental ways relative to those of positivism and interpretivism. A full comparison of these differences is beyond the scope of the current article.[2] One key difference to be highlighted involves the concept of causality and the central role it plays in understanding the potential and practical application of CR to the conduct of IS and case study research. Causality refers to the relationship between an action or thing (cause) and the outcome (effect) it generates. Often, our ability to explain a given phenomenon requires the identification of the factors and relationships which cause it to occur (Gregor 2006).

Research has typically pursued descriptions of causality in one of two ways. First, researchers attempt to "explain" a phenomenon by postulating a relationship between conceptual entities. Following a generally Humean conception of causation (Lee et al. 1997), researchers seek to develop confidence in the proposed explanation using repeated observations combined with statistical methods. In the second approach, researchers generate explanations of how actors understand and interpret their roles in a particular social setting, and how subjective meanings are developed and sustained. This is generally presented as a detailed description of events that reflects the primary actors' and researchers' interpretations of meanings and intentionality, and the reciprocal influences of social action and context (Orlikowski and Baroudi 1991).

A primary objective of CR-based research is to provide clear, concise, and empirically supported statements about causation, specifically how and why a phenomenon occurred. We can ascribe causality "if and only if it is the case that some event E would not have occurred, under the conditions that actually prevailed but for (the operation of) X" (Bhaskar 1998, p. 101). Within CR, causation is not based on regular successions of events or a correlational assessment of event regularities (Sayer 2000). CR shifts the focus to explicitly describing causality by detailing the means or processes by which events are generated by structures, actions, and contextual conditions involved in a particular setting. This view of causality is reflected in the ontological and epistemological assumptions upon which critical realism is founded as well as the proposed methodological principles. The nature of causality and requirements for making causal statements within CR will be further elaborated as these principles are discussed in the following sections.

Ontological Assumptions

Ontology is concerned with the nature of objects being studied, including the nature and characteristics of the various entities that exist in the world, and whether this reality exists objectively or subjectively relative to humans (Chua 1986; Orlikowski and Baroudi 1991). Ontologically, critical realism is based on the following basic assumptions: existence of an

[2]For detailed comparisons of the paradigmatic assumptions of positivism, interpretivism and CR, see Fleetwood (2005), Mingers (2004 a, 2004b), Smith (2006), and Wynn and Williams (2008).

independent reality; a stratified ontology comprised of structures, mechanisms, events, and experiences; emergent powers dependent upon but not reducible to lower-level powers; and an open systems perspective (Bhaskar 1975, 1986, 1998; Collier 1994; Danermark et al. 2002; Sayer 1992).

Independent Reality

Critical realism is a particular form of realism that acknowledges the world and entities that constitute reality actually exist "out there," independent[3] of human knowledge or our ability to perceive them. This independence does not depend on any direct knowledge or subjective beliefs regarding the existence of any entities. Rather, CR recognizes that the world is not easily reducible to our perceptions and experiences. In other words, the nature of reality is not easily and unproblematically apprehended, characterized, or measured, which means that humans experience only a portion of it.

Thus, the conduct of research investigating reality is concerned with two different dimensions of science, and thus two distinct sets of real entities (Bhaskar 1975). The entities which comprise the world are part of an intransitive dimension that operates independently of humans and their ability to understand or perceive it. Our knowledge of these entities and beliefs about their causal efficacy, which have been generated by reason and scientific research, are part of a transitive dimension that is constantly subject to revision and reinterpretation. As such, CR holds thought-objects such as our beliefs, theories, and concepts about the entities that constitute reality (which are constantly subject to revision or reinterpretation) to be ontologically real, yet distinct from the entities themselves.

Stratified Ontology

A key aspect of CR is the stratification of reality into three nested domains (Bhaskar 1975), as shown in Table 1. The domain of the *real* includes the entities and structures of reality and the causal powers inherent to them as they independently exist. The next domain, the *actual*, is a subset of the real that includes the events that occur when the causal powers of structures and entities are enacted, regardless of whether or not these are observed by humans. The final domain, the *empirical*, is a subset of the actual and consists of those events which we are able to experience via perception or measurement. The three domains are nested such that events in the domain of the actual that occur, because a mechanism is activated, are not necessarily perceived as experiences in the domain of the empirical. Likewise there are mechanisms which exist in the domain of the real but that are not activated, or are activated but counteracted by other mechanisms, and thus do not produce events in the domain of the actual.

This stratified ontology contrasts with the ontological assumptions of positivism and interpretivism, and is a key to understanding the distinctive nature of critical realism. Positivism assumes a flat ontology that reduces reality to a Humean conjunction of cause with effect and has little regard for the mechanisms which link them (Joseph 1998). Interpretivism typically holds that reality is constructed either individually or socially (Walsham 1995) and thus can only be understood through an analysis of actors' meanings and actions. Strong forms of interpretivism view reality as not existing independently of human knowledge altogether. In contrast to these positions, CR asserts that general elements of an independent reality (e.g., some structures and mechanisms) exist, but our knowledge of specific structures and mechanisms is limited because of the difficulty of accessing them directly through the levels of stratification. CR attempts to use our knowledge of the experiences in a given situation to analyze inferentially what the world must be like in terms of the structures and mechanisms that must constitute this reality for some accepted outcome to have occurred (Mingers 2004b). In so doing, CR accepts that the socially constructed view of reality held by a given actor or actors may be incorrect with respect to the intransitive domain of an independent reality. The implications of this view of reality are the foundations upon which CR-based epistemology and methodological practices are built. In this section, we discuss each of the ontological components of CR in more detail.

Structure

In critical realism, structure is defined as the "set of internally related objects or practices" (Sayer 1992, p. 92; see also Danermark et al. 2002, p. 47) that constitute the *real* entities we seek to investigate in a specific contextual situation. These structures may be part of a larger structure, and also may contain a number of component substructures. Examples of structure include a national market system, a single organization, or even smaller nonsocial structures at the neurological level or below (Sayer 1992). The ontological value of these structures is that they have characteristics and tendencies

[3]The terms *objective* and *independent* are frequently used synonymously when describing ontological assumptions regarding the nature of reality (e.g., Chua 1986;Orlikowski and Baroudi 1991). We adopt the term *independent reality* so as to avoid possible confusion arising from alternative meanings associated with the term objective (see Sayer 2000, p. 58).

Table 1. Stratified Ontology of Critical Realism (adapted from Bhaskar 1975, p. 13)

	Domain of Real	Domain of Actual	Domain of Empirical
Mechanisms	×		
Events	×	×	
Experiences	×	×	×

that cannot be reduced to those of their component entities. Instead, the relationships among the various entities in a structure endow it with novel properties that are distinct to the structure itself. For instance, water is composed of hydrogen and oxygen, but its characteristics cannot be readily attributed to those of the elements themselves.

We are typically confronted in IS contexts with a socio-technical environment consisting of several interacting structures, each of which has the potential to impact the existing situation to generate the events. This structure typically includes a social structure consisting of individuals, groups, and organizations, along with a set of rules and practices, technological artifacts (e.g., software tools and information technologies), and discursive entities such as language and culture (Fleetwood 2005). According to CR, *social structures* have several characteristics that distinguish them from physical structures. Social structures both constrain and enable social activities, and are themselves reproduced or transformed by these activities (Archer 1995; Bhaskar 1998; Mingers 2006). In addition, social structures do not exist independently of agents' conceptions of their own activities set within the structures. This does not imply that human agents have perfect knowledge of their actions or their consequences; only that agents must have some interpretation of the social structure in order to understand the meaning behind their own actions and those of other agents. Finally, social structures and the powers they possess are not necessarily enduring across periods of time or varying contexts, in large part due to the open systems in which they exist.

Mechanisms

Conceptually, mechanisms are "nothing other than the ways of acting of things" (Bhaskar 1975, p. 14). Mechanisms are inherent to physical and social structures, enabling or limiting what can happen within a given context (Sayer 2000; Smith 2006). Mechanisms can be conceptualized as either causal powers or tendencies (Fleetwood 2004; Sayer 1992; Smith 2006). Causal powers are the "dispositions, capacities, and potentials to do certain things, but not others" (Fleetwood 2004, p. 46) that arise from the essential nature of the entities themselves. Entities typically possess an ensemble of powers, which may or may not be enacted in a given context to generate the events manifest as empirical experiences. For instance, copper has the power to conduct electricity based on the physical nature of the free electrons available in each atom. As such, this power is present in a piece of copper whether or not it is connected in an electrical circuit at a given point in time.

Tendencies go beyond powers to distinguish specific classes of things from others. Whereas powers designate possibilities, tendencies describe those actions which are characteristic or typical of a given class, species, or type of thing. As Bhaskar explains, "All men…possess the power to steal; kleptomaniacs possess the tendency to do so" (1975, p. 230). This is not to identify tendencies as actions that are *expected* to occur in some law-like regular pattern, but as a possible, if not plausible, course of action. In addition, the expected outcome of an enacted tendency may not result in an event in the actual domain. Other mechanisms may also be enacted within the given structure in such as way as to prevent or alter the realization of a particular causal effect. As such, "a tendency may never actually be realized" (Manicas 1987, p. 41).

To the extent that individual actors are components of the structures in which a given set of events take place, they must be considered as bearing causal powers based on their thoughts and beliefs of how given actions are linked to consequences (Bhaskar 1998; Groff 2004). An actor's beliefs or reasons that motivate intentional behaviors correspond to a tendency to act in certain ways (Bhaskar 1998). As a result, CR views an actor's reasons as the generative mechanisms (i.e., powers) which are the cause of a given action (Archer 1995; Bhaskar 1998). Each action may in turn trigger subsequent mechanisms on the part of other entities within the structure, leading to outcomes contrary to those expected or intended when the action was initiated. While reasons and beliefs may adequately explain a particular action, they do not necessarily determine its ultimate consequences. Not all causal mechanisms are attributable to human actors. Other entities in IS research settings, including social structures, physical objects, and technological artifacts such as software

applications, will be the source of emergent powers that, along with actors' beliefs, exert causal influence and may be appropriate to examine.

Events

An *event* can be defined as a specific happening or action resulting from the enactment of one or more mechanisms. In CR, events are ontologically distinct from the structures and mechanisms that generate them (Bhaskar 1975). Although these events are the result of the enactment of causal powers or tendencies emanating from a structure, it is possible that no change occurs because of the counteracting effects of one or more other mechanisms (Gambetta 1998). It is also possible that the outcome of one mechanism may exacerbate the effects of another mechanism, further varying the direction, magnitude, or perceptibility of actual events. An example would be the human tendency to lose one's temper in a given situation, but with no real change or action due to the offsetting exercise of self-control (Bhaskar 1975, p. 99).

Although a multitude of events may be generated and have some actual effect (or non-effect), limitations in our ability to discern or measure these effects restrict our access to them. This is especially true for complex events which are less likely to be directly perceived. We may only come to know these complex events by abstracting them from their observable effects rather than our perception of them.

Experiences

Experiences are those events which we are able to directly observe, often through our sensory perceptions or via sensory-enhancing tools. Consistent with the assumption of an independent and stratified reality, CR recognizes that experiences are only a subset of the actual events generated in a given context. It may be possible to experience events directly, for example, as part of laboratory experiments within closed systems, but this is the exception rather than the rule (Bhaskar 1975; Collier 1994). Within real-life scenarios, such direct observation is rarely possible. Further, the limited instances of events that can be directly perceived (i.e., experiences), as a subset of the actual events, may under-specify the entirety of the events actually occurring and the mechanisms generating them.[4]

Logically, the existence of a world in which many significant events occur without being observed or perceived by anyone is an assumption upon which scientific discovery is based. Scientists routinely assume the existence of certain structures or theoretical entities before embarking on research programs designed to find direct observations to support their existence. However, our experiences may be incorrectly attributed to the actual events that occurred. Subsequent research often provides further evidence supporting an alternative interpretation of events. Thus, CR holds that events occurring within a given structure are ontologically independent of the experiences which we are capable of empirically observing and measuring (Bhaskar 1975).

Emergence

According to the ontology of CR, entities are independent from, and irreducible to, the components of which they are comprised (Archer 1995). The properties, capabilities, and powers that can be ascribed to a given entity or structure depend on not only those aggregated from the components, but also on the synergistic effects resulting from the pattern of their organization. Thus, the properties of a given structure *emerge* from the interactions between the components themselves and their causal powers, but do not enable the structure to be defined simply by identifying the characteristics of the components. This is particularly relevant in social structures and phenomenon. "Explanation of why things social are so and not otherwise depends on an account of how the properties and powers of the 'people' causally intertwine" (Archer 1995, p. 15), and not based on looking at the individuals in isolation (Easton 2010). It is also possible that mechanisms are identified as emerging from structural components at lower levels than the focus of analysis. This emphasizes the need to maintain clarity in specifying the structure and the connectedness of elements within and between levels (Easton 2010).

Open Systems Perspective

Critical realism adopts a view of reality as an open system (Bhaskar 1998) that is beyond our ability to control directly. Within many of the natural and physical sciences, it is possible to design laboratory experiments as more or less *closed systems* in which contextual conditions and exogenous influences are controlled in order to make the phenomenon visible by reducing confounding effects and to ensure a common environment for replicated investigations. Within these closed experiments it is possible to isolate the specific causes of a given outcome event or state change.

[4]We appreciate the input from the associate editor to clarify this point.

Social systems and other complex phenomena seldom exhibit such experimental or spontaneous closure (Bhaskar 1998). Social systems, such as socio-technical systems in organizational settings, cannot adequately be constrained in the real world as can be done with laboratory experiments. Each event is not only dependent on the causal powers available within a social structure, but also on the continuously changing contextual conditions and the evolving properties of components within the structure. As mechanisms are enacted, the structure is modified as a result of their effects (Archer 1995), making constant contextual conditions a rare exception. Instead, because the boundaries of social systems are typically fluid and permeable, we are unable to assume that the mechanisms that were enacted in a given system and environmental context will generate the same events if enacted in the future. In CR, the dynamic and variable reality of open systems shifts the focus onto identifying the tendency of mechanisms to act within a specific contextual environment at a specified time (Sayer 1992).

Critical Realism Epistemology

Epistemological assumptions are concerned with the notion of what counts as acceptable truth by specifying the source, characteristics, and assessment of truth claims (Chua 1986). One's epistemological assumptions determine how to acquire and develop knowledge claims, how to evaluate the truth or validity of these claims, and how these claims are to be measured against existing knowledge.

Critical realism seeks to posit descriptions of reality based on an analysis of the experiences observed and interpreted by the participants, along with other types of data. The resulting knowledge claims are focused on specifying and describing those elements of reality which must exist in order for the events and experiences under examination to have occurred. The nature and form of these knowledge claims are derived from specific epistemological assumptions linked to the ontological premises of CR. The epistemological assumptions discussed in this section include mediated knowledge, explanation rather than prediction or understanding, explanation by mechanisms, unobservability of mechanisms, and multiple possible mechanisms (Bhaskar 1975; Collier 1994; Sayer 1992).

Mediated Knowledge

CR defines scientific knowledge as having both transitive and intransitive dimensions (Bhaskar 1975). The intransitive dimension includes the elements of the world that we seek to explain, which are largely independent of our senses and experiences. The transitive dimension includes researchers' observations, as well as theories about the independent world that have been developed as the result of scientific inquiry (Collier 1994). However, CR also acknowledges that a perfect match between theories and reality is unlikely, resulting in a base of knowledge that is fallible but presumably less so over time. The intransitive entities do not necessarily change in the natural world but the knowledge objects of the transitive dimension (i.e., our theories) will change.

CR assumes that our knowledge of the intransitive entities that comprise an independent reality is formed in the transitive dimension, mediated by the social structures to which we belong (i.e., other researchers, disciplinary groups, coworkers, etc.). This knowledge of underlying structures and mechanisms is not created *ex nihilo* but formed in conjunction with existing social interactions and beliefs along with our own sensory and conceptual interpretations. Thus, all knowledge in CR is value aware and theoretically informed, derived from multiple value-aware perceptions of a single independent reality (Healy and Perry 2000).

Explanation Rather than Prediction

The goal of a CR study is *explanation* of the mechanisms that generate a certain event, more so than the ability to make *predictions* about future events or to *understand* the social/cultural meanings behind the events. An explanation stipulates the factors presumed to cause a given outcome (Yin 2003). CR holds that one can rarely (if ever) identify a complete set of precedents which will *always* lead to an outcome because of the possible interaction of mechanisms subsequently enacted by structural entities and contextual factors in an open system. As such, explanation in CR seeks to identify the causes of a particular phenomenon that has occurred. This differs from the ability to make precise predictions, which require that we are able to control or determine the specific conditions affecting the enactment of a given set of mechanisms in order to correctly anticipate a given outcome. An open systems view of the world includes the recognition that regularly occurring events within a complex setting such as a socio-technical system are the exception in reality because the effects of available mechanisms are seldom identical across multiple events and contexts. The lack of closure in complex social systems (e.g., organizations or socio-technical systems common in IS studies) makes it far more difficult (if not impossible) to predict the events that result from a given initial event or change in structure (Bhaskar 1975). Thus, the

theories developed using CR as an underlying philosophical framework are largely restricted to providing an explanation of the reasons a phenomenon occurred in a given complex social system (Bhaskar 1975).

Open systems do not preclude the manifestation of a specific causal mechanism in different but characteristically similar settings, or the reoccurrence of that mechanism in the same setting. One can easily find similarities in a variety of socio-technical phenomenon such as how organizations are structured, the types of software systems used, or how IS project teams go about implementing enterprise software systems. Common physical and social structural elements and contextual factors may be at work leading to similar experiences occurring at various levels of observation. This may be the case even though the unfolding of specific events and the ultimate outcomes experienced are quite different. This potential regularity in structures and the events generated by causal mechanisms is known as a demi-regularity. A demi-regularity, or demi-reg, is a partial event regularity indicating the occasional realization of a causal mechanism, with relatively enduring tendencies, in a bounded region of time and space (Lawson 1997).

Demi-regs can be leveraged with respect to explanation in two ways. First, we may look at a common phenomenon in similar contextual settings (e.g., the implementation of a particular enterprise system in different organizations that share important characteristics) not as a basis for prediction but to explore the existence and activation of a mechanism within each unique setting. Alternatively, we may identify fundamentally different outcomes in settings where structural, contextual, and environmental factors may lead us to expect some generally similar manifestations of mechanisms. These contrastive demi-regs offer the potential to fundamentally alter our understanding of a causal mechanism (Lawson 1997). In both instances, demi-regs offer the potential to deepen and generalize our knowledge of causality and the manifestation of mechanisms through structures.

Explanation Via Mechanisms

The purpose of a critical realist study is to explain a given set of events by uncovering the hypothesized existence of mechanisms which, if they existed and were enacted, could have produced these events (Bhaskar 1975, 1998). Given a set of empirical facts regarding a focal event (i.e., phenomenon of interest) and context, CR attempts to answer the following question: What must reality be like in order for this event to have occurred? A CR researcher's goal is to identify the mechanisms that emerge from the components of a physical and social structure to produce the events of interest (Sayer 1992). Ultimately, the theories that result must be able to identify not only the structures and mechanisms themselves, in the form of theories for analyzing (Gregor 2006), but also the interrelationships between them and the means by which they generated the phenomena we wish to explain (Keat and Urry 1975). This includes the identification of the conditions that encouraged (enabling conditions), triggered or reinforced (stimulus conditions), or removed impediments to (releasing conditions) the exercise of the hypothesized powers and tendencies (Bhaskar 1975; Hartwig 2007). Thus, the resultant causal explanation will account for a set of existing and enacted mechanisms, along with the impact of any structural factors and relevant conditions that generated the outcome being studied.

Unobservability of Mechanisms

In critical realism, the belief in the existence of a mechanism is constrained by the fact that these mechanisms are often neither directly observable nor measurable. Bhaskar argues that it is rare that such mechanisms "are actually manifest and rarer still that they are empirically identified by men" (1975, p. 47). However, this is not to imply that mechanisms are either *necessarily* observable or *necessarily* unobservable: "Observability may make us more confident about what we think exists, but existence itself is not dependent on it" (Sayer 2000, p. 12).

Knowledge of reality is not always based on an ability to be perceived, but an ability to do (Bhaskar 1998, p. 12). In other words, our belief in the existence of a mechanism can be based either on our ability to directly observe it (perceptual criteria), with or without tools to do so, or on our ability to observe its effects (causal criteria) (Bhaskar 1975, p. 179). In the latter case, unobservable mechanisms and structural entities may ultimately become observable by direct means as new instruments or measures are developed in subsequent research or subsequent phases of a single research program.

The implication of unobservability of mechanisms is that our efforts to create knowledge about the real domain will focus not on accessing elements of structure and causal mechanisms directly but rather coming to know their manifest effects. Our knowledge of these entities will, therefore, depend upon "a rare blending of intellectual, practico-technical, and perceptual skills" (Bhaskar 1975, p. 47). In other words, where we cannot observe them, we must depend on an ability to identify them by *inferring* their existence based on the observable experiences we believe them to have caused.

Multiple Possible Explanations

In most cases, there will be multiple possible sets of mechanisms which may have produced the outcomes being studied in a given research program. Because CR acknowledges that the underlying structure and mechanisms are situated within an open system and that we are typically unable to observe every aspect of the phenomenon, the elements that comprise a given structure are subject to the influence of a wide variety of *possible* internal and external conditions and effects. This influence may be realized in varying ways in different time periods or as new contextual conditions are encountered. As various combinations of mechanisms are hypothesized, it may be possible to arrive at multiple explanations of an event that are subject to both multifinality (similar initial conditions and mechanisms leading to varying end effects) and equifinality (dissimilar conditions and mechanisms leading to similar end effects). Typically it is impossible to precisely identify the exact causes behind a given outcome and to eliminate all other possible factors that might have been causally sufficient. Thus, care must be taken in identifying the effects of hypothesized mechanisms and eliminating "what will always constitute a plurality of possible causes in open systems" (Bhaskar 1993, p. 133).

The existence of multiple possible explanations establishes the need for some means of evaluating and comparing alternative explanations. This leads to what CR theorists have described as *judgmental rationality* in which theory selection is made by comparing the explanatory power of alternative theories in the transitive dimension instead of attempting to compare these theories with real entities in the intransitive dimension, which may be unobservable (Bhaskar 1986; Groff 2004). Thus, the explanation we select as the most likely cause of a given phenomenon consists of the set of mechanisms which interact to generate the most accurate representation of the "real world" given our existing knowledge.

Methodological Principles Derived from Critical Realism

A primary objective of scientific research conducted under CR is to develop explanations for the way things act and how they are capable of so doing. A number of strategies for CR-based research have been described including the identification of specific mechanisms, explanations of how mechanisms and context interact, and descriptions of the context within which mechanisms operate (Ackroyd 2010). In information systems, the greatest potential contribution of CR-based research comes from developing context-specific causal explanations of socio-technical phenomena by explicating the specific mechanisms which generate them.

While Bhaskar did not recommend a specific research methodology, several CR researchers have identified the case study method as the best approach to explore the interaction of structure, events, actions, and context to identify and explicate causal mechanisms (Ackroyd 2010; Easton 2010; Miles and Huberman 1994; Mingers 2004b). A case study "involves investigating one or a small number of social entities or situations about which data are collected using multiple sources of data" (Easton, 2010 p. 119). "A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin 2003, p. 13). By focusing on a "sustained consideration of activities and behavior in a particular location" (Ackroyd, 2010, p. 535),

> the case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points, and… relies on multiple sources of evidence, with data needing to converge in a triangulating fashion" (Yin 2003, p. 13-14).

For the purpose of studying contemporary socio-technical phenomenon to uncover the causal mechanisms and contextual factors that combined to generate them, case study research is well-suited to conduct critical realist research. Thus, we establish the research boundary of the proposed methodological principles as the explication of the causes for events of interest (socio-technical phenomenon) dealing with the creation, implementation, or use of information systems using the case study method.

We propose five methodological principles for the conduct and evaluation of critical realist research using explanatory case studies (see Table 2 for a summary). The principles are derived from both the ontological and epistemological premises of CR as shown in Figure 1 and Table 2. The term *principle* has a very specific meaning. We use it in a way that is similar to the guidance offered for interpretivist field studies (Klein and Myers 1999), design science research (Hevner et al. 2004), and critical theory research (Myers and Klein 2011). Our principles are fundamental ideas meant to assist authors and reviewers in conducting and evaluating critical realist research. These ideas are based on the originating concepts and writings of this relatively new philosophy of science. The principles summarize important insights and essential requirements for effectively employing CR as the basis for conducting IS research.

Table 2. Methodological Principles of Critical Realism

CR Principle	Ontological and Epistemological Basis	Evaluation Criteria	Examples from CR Case Studies in Information Systems
Explication of Events Identify and abstract the events being studied, usually *from experiences*, as a foundation for understanding what really happened in the underlying phenomena.	• Stratified ontology • Mediated knowledge	• Thick description of case "story" including actions and outcomes • An abstracted sequence of events (including the experiences of participants and observers)	• Morton (2006) described a detailed sequence of five composite events associated with the strategic IS planning project. • Volkoff et al. (2007) abstracted core events from empirical observations as changes to structure associated with an IS implementation.
Explication of Structure and Context Identify components of social and physical structure, contextual environment, along with relationships among them. (Critically redescribed from actor's viewpoint into theoretical perspective.)	• Stratified ontology • Open-systems perspective • Mediated knowledge • Unobservability of mechanisms	• Description of the structural entities, constituent parts, and contextual conditions existing in the case • Identification of the relationships among the entities • Explication of changes to the structure • Description of the resulting emergent properties	• Bygstad (2010) identified various elements of the information infrastructure, and the relationships among them. • Morton (2006) identified organization units and actors as primary structural entities, and described three structural relationships with causal implications for observed outcomes. • Volkoff et al. (2007) explored elements of structure, structure changes, and contextual influences by focusing on participant activities, responsibilities, and interactions.
Retroduction Identify and elaborate on powers/tendencies of structure that may have interacted to generate explicated events.	• Emergence • Focus on explanation • Explanation via mechanisms • Multiple explanations • Unobservability of mechanisms	• Identification of a set of plausible candidate causal mechanisms • Logical and analytical support for the existence of proposed mechanisms linking the structure to events	• Bygstad (2010) explained how the emergent higher level structures affect lower level entities and vice versa in identifying the innovation reinforcement and service reinforcement mechanisms.
Empirical Corroboration Ensure that proposed mechanisms have causal power and that they have better explanatory power than alternatives.	• Independent reality • Stratified ontology • Unobservability of mechanisms • Multiple explanations	• Analytical validation of proposed mechanism based on case data • Assessment of explanatory power of each mechanism relative to alternative explanations • Selection of the mechanism(s) that offers the *best explanation*	• Volkoff et al. (2007) and Morton (2006) demonstrated causal efficacy by using the hypothesized mechanisms to explain other events occurring in the cases. • Bygstad (2010) discussed a comparative analysis of candidate mechanisms to determine which offered the strongest explanatory power.
Triangulation & Multimethods Employ multiple approaches to support causal analysis based on a variety of data types and sources, analytical methods, investigators, and theories.	• Independent reality • Mediated knowledge • Unobservability of mechanisms • Multiple explanations	• Multiple theoretical perspectives • Multiple analytical and methodological techniques • Variety of data sources and types • Multiple investigators	• Zachariadis et al. (2010) integrated a series of studies based on interview data, econometric analysis, survey data, and historical analysis. • Volkoff et al. (2007) utilized multiple data sources, data types, and investigators.

To enhance the presentation of each principle, we include several examples from empirical CR-based case studies to illustrate what may otherwise be relatively abstract philosophical points. These examples serve to concretize the principles further relative to how other researchers have interpreted and applied the concepts of CR in case study research. A number of models for creating causal explanations in CR have been offered (e.g., Bhaskar 1986, 1998; Danermark et al. 2002; Mingers 2006). The proposed methodological principles are consistent with and leverage aspects of these models. A more detailed comparison of the proposed principles and prior models is presented in Appendix A.

The principles are not intended to be pursued in isolation or in a structured, step-by-step procedure. Rather, the principles are interdependent and are likely to be addressed as a research project is planned, and in parallel and iteratively during data collection and analysis. The dynamic nature of the relationships between the methodological principles is represented in Figure 2, which demonstrates the conceptual flow in conducting CR-based case study research while identifying the linkages between and dependencies of the proposed principles. These linkages are described in the explication of the principles and in the research examples.

Explication of Events

The principle of explication of events describes the necessity to identify the detailed aspects of events being studied, usu-

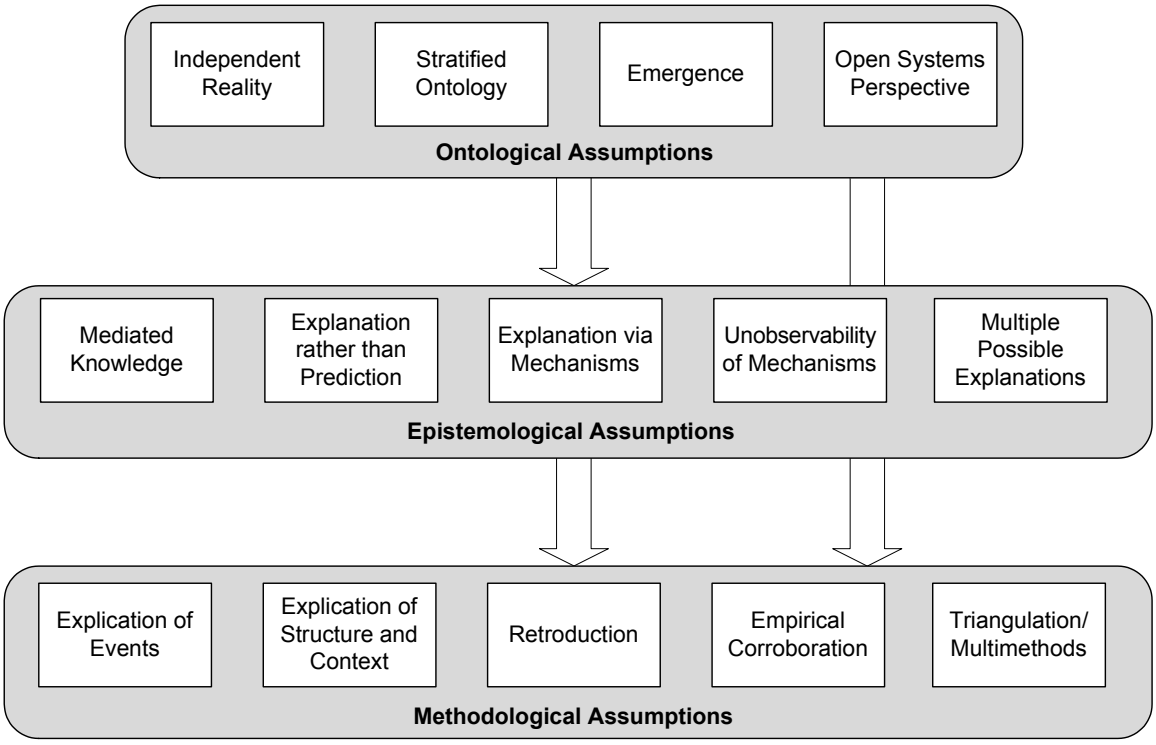

Figure 1. Ontological and Epistemological Assumptions of CR and the Methodological Principles

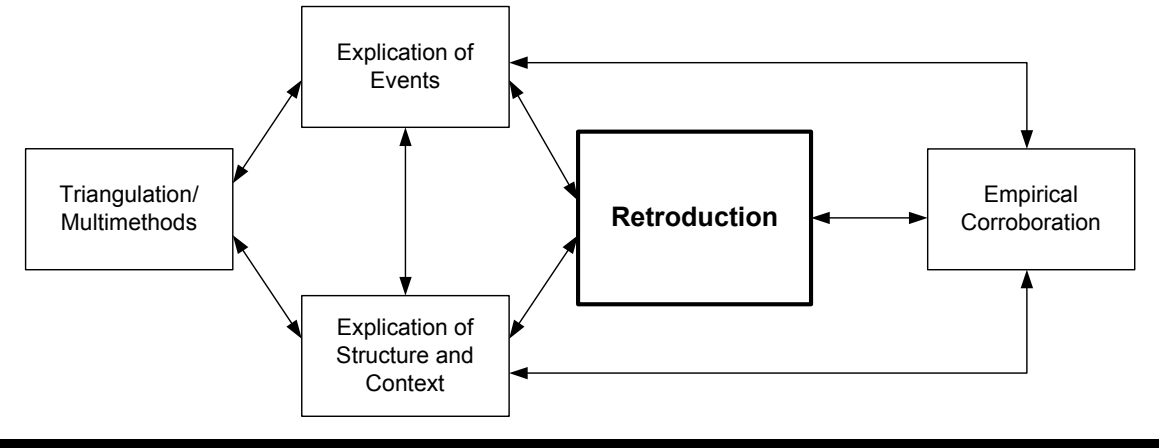

Figure 2. Relationships among the Methodological Principles

ally through the abstraction of experiences, as the foundation of causal analysis. We derive this first principle from the ontological assumption of a stratified ontology and the epistemological assumption of mediated knowledge. Through CR-based case study research, we seek to develop a causal, transitive explanation of a complex socio-technical phenomenon, happening, or outcome. A starting point to develop this explanation is the identification and detailed explication of the event or events that constitute the outcome under study. Empirically observed experiences perceived both by the participants and the researchers, along with various outcomes identified and measured by empirical means, are abstracted to allow the researcher to describe and explicate in detail those events believed to have actually occurred. This abstraction of

experiences may take the form of an aggregation of minute actions to highlight higher level factors, a reinterpretation to expose structural elements or causal factors, or a reframing through the lens of existing theory. The specifics of this explication do not necessarily require that events be described to some higher, conceptual level. It seeks to impose some order and organization on the observed experiences in the case. A detailed explication of the events is crucial for identifying elements of physical and social structure, agency, and the contextual environment that are causally relevant. Explication of the observed experiences through thick description provides the basis for abstracting the complex events from the empirical observations (Danermark et al. 2002) that frame the target phenomenon.

The descriptions of the events include details of key actions and outcomes, and the specific structural components that were involved. The sequence of these events provides evidence of the effects of the causal chain that constitutes a change, or unexpected non-change, in the structure of the research setting. Developing a detailed, explicit sequence of events enables subsequent structural and causal analysis. In other words, the events are not part of the theory but tools by which the researcher can develop theories. Thus, by identifying and explicating the events, the foundation is established for identifying the elements of structure and context from which these events emerge, as well as the mechanisms that were enacted accordingly.

The relationship between events and experiences can be both complex and challenging to unwind. Events can be identified at very different levels and constitute very different frames such as a "year, a merger, a decision, a meeting, a conversation, or a handshake" (Langley 1999, p. 693). Experiences can be related to more than one event, events of different types and scope can be overlapping or embedded, and the perceived relationship between events and experiences can change over time as related events unfold and are explored (Van de Ven 2007). The understanding of specific experiences, how these experiences are abstracted into events, and the significance of these events to the unfolding causal process will evolve. In general, experiences can be viewed as a subset of events, and explication of the events may require iteration in analysis as the research unfolds and other methodological principles are addressed. For example, as we theorize that a specific event must have taken place to explain one or more observable experiences, we may be required to explicate this additional event.

Morton (2006) describes a detailed sequence of the events encountered in the strategic information systems planning (SISP) process for a national government organization. As conceptualized by Morton, the SISP initiative "triggers various kinds of responses from existing social structures and agents" (p. 7). It is these responses that interact to generate the resulting events and empirical experiences, which Morton classifies as outcomes. Morton identifies five broad outcomes which build upon each other: the initiation of the SISP consultancy, the consultant's analysis, the recommended solution, establishing the business case, and implementation. Each outcome includes a thick description and sequencing of the the actions taken by key participants, the results of these actions, meetings, and presentations, and the structural components involved. For example, the first outcome describes the rationale the divisional manager used to initiate the consultancy project, including a lack of an existing strategic plan, inefficient resource allocations, and an unfavorable opinion of the IT branch by the board of directors. At one level this sequence of events resembles the phases of a typical consulting project. However, Morton's detailed discussion of the specific actions taken at each step enables a more rigorous understanding of the interaction of the agents in this particular organizational setting. In so doing, this description forms the framework for the fulfillment of the other principles.

Explication of Structure and Context

Through the principle of explication of structure and context, we seek to identify and analytically resolve the components of the structure that are causally relevant. Describing causal tendencies that generate events is central to CR. To understand the source of these tendencies, we identify those components of the structure, variations in contextual influences produced in open systems, and other potentially activated mechanisms which interact to produce the complex causal chain leading to the phenomena of interest. We seek to answer the question: "What is it *about* the structures which might produce the effects at issue?" (Sayer 1992, p. 95).

Complex, open-system organizational environments introduce a myriad of structural entities and contextual factors that influence the events of study. These include social, physical, artifactual, or symbolic entities, and the relationships among them (Fleetwood 2005). As elements of the domain of the real, structural entities are similar to mechanisms in that they are typically not observable directly, but are knowable primarily by their artifacts and effects. As such, our knowledge of them is formed in the transitive dimension, mediated by our experiences, values, social structures, and existing theory.

In order to theorize about the causes behind a series of events, it is first necessary to decompose the relevant structure into its constituent parts such as actors, rules, relationships, etc.

(Elder-Vass 2007) as they are encountered in the event descriptions. The connections and interdependencies between these components are defined, along with a conceptual description which enables them to be linked to the outcome of interest. Potential causal linkages between the structure and focal events are derived from analysis based on questions such as

> What does the existence of this object (in this form) presuppose? Can it exist on its own as such? If not what else must be present? What is it *about* the object that makes it do such and such? (Sayer 1992, p. 91).

The analysis identifies the fundamental properties and tendencies of structural entities to do certain things, and their relationships which combine to produce the emergent properties of the structure as a whole. It is a process of abstraction that can be extended by redescribing the component parts of structure and their relationships in terms of existing theories and frameworks that provide leverage for potential explanations (Bhaskar 1975). In so doing, different theoretical interpretations of the effect of structure and context on the outcome can be compared and integrated into the resulting analysis (Danermark et al. 2002).

A full accounting of the powers and liabilities derived from the various structures may prove to be extremely complex, if even possible, as we transcend levels of explanation. Parsimony, and limitations of time and resources, may dictate that one refrain from a comprehensive description of the structural parts and contextual influences comprising a specific research project, instead focusing on those parts which are most relevant for the given research objectives. To help maintain focus, it is important to consider the purpose and context of the research or intervention. Motivations such as why a particular research project is being conducted, at a specific point in time, and within a particular locale can help determine things like the relevant time horizon (e.g., days, week, months, years, etc.) and also the appropriate boundaries for the inquiry (e.g., this department, this firm, this system/software, these types of situations in general).

In a recent CR-based case study, Bygstad (2010) emphasized the identification of the various elements of an information infrastructure and sought to understand how this structure enabled the generation of innovation in ICT-based services (and ultimately vice versa). The structure of interest was identified as the information infrastructure of an international airline seeking to diversify its service offerings. In order to identify and describe this structure, "the key actors and systems were identified, and a comprehensive analysis of business strategy and information infrastructure was conducted, focusing particularly on the interplay between different levels" (p. 161). Using the work of DeLanda (2006), the information infrastructure was characterized as an assemblage that included both social and technical entities which can be combined and operate at multiple levels. This provided a useful framing to explore the emergent properties of the information infrastructure. Bygstad identified the user group of the new service offering, IT and marketing departments, senior managers, the business strategy, external vendors, consultants, and the IT architecture itself (e.g., web sites, databases, interfaces and web services) as the relevant structural components in the case. The structural analysis also explored the interactions among the various entities focusing on transitions between levels from the technology to the service user group. Bygstad explored potential causal links emerging from the structural entities as events surrounding the service innovation moved "from ideas to designs and finally to solutions" (p. 161). This provided the basis for identification of specific causal mechanisms driving information infrastructure innovations.

Retroduction

Recalling our conceptualization of mechanisms as causal powers or tendencies, we portray retroduction as an attempt to link the capacities that are inherent within the explicated structural components and their relationships to the specific events which we seek to explain. The principle of retroduction, the core of the CR explanatory model, is derived from the ontological assumption of emergence and epistemological focus on explanation, the use of causal mechanisms as the basis for this explanation, the potential for multiple potential explanations, and the knowledge that these causal mechanisms may or may not be observable empirically. Philosophically, retroduction is a form of inference that seeks to meet the CR goal of explaining by identifying and verifying the existence of a set of mechanisms which are theorized to have generated the phenomena under study.[5] In retroduction, "we take some unexplained phenomenon and propose hypothetical mechanisms that, *if they existed*, would generate or cause that which is to be explained," (Mingers 2004b, p. 94). Stated differently, retroduction is a "mode of inference in

[5]Retroduction and retrodiction both refer to the same logic form : identifying what reality must be like (i.e., what mechanism must exist) for the observed event to have occurred. This logic form is also identified as abduction (Buchler 1955; Peirce 1957). Retrodiction refers to the application of previously identified mechanisms to the explanation of an outcome in a new setting, whereas retroduction refers to efforts to identify new mechanisms. We use the term retroduction for both applications of the logic form.

which *events* are explained by postulating (and identifying) mechanisms which are capable of producing them" (Sayer 1992, p.107, emphasis added).

Retroduction differs from other forms of inference typically used in case study research. In deduction, researchers use accepted theories to derive new theoretical relationships. These are operationalized and subjected to empirical tests seeking to falsify the hypothesized relationships (Dubin 1978; Lee 1989). Inductive research—for example, grounded theory (Glaser and Strauss 1967) or analytic induction (Ragin 1994; Robinson 1951)—begins with empirical data which is analyzed to identify categories, conceptual/theoretical entities, and patterns among them, without necessarily requiring additional theorizing regarding the existence of any entities not represented in the empirical data. The observed patterns and commonalities are then assumed to hold as new theory.

If there are existing mechanisms in the theoretical knowledge of a field, they are adapted to fit the specifics of the given case. However, if no existing mechanisms are adequate to explain the phenomena being studied within a specific context, a new mechanism (or set of mechanisms) is proposed which, "if it were to exist and act in the postulated way would account for the phenomenon in question" (Bhaskar 1975, p. 12).

Depending on the specific nature of the research question and unit of analysis, the resulting set of mechanisms may include the reasons and beliefs held by individual actors. These mechanisms may be identified by analyzing the actions performed by individual actors, as well as the actors' stated or inferred reasons for doing so (Groff 2004). An understanding of a given action will depend upon an explanation of the interpreted beliefs that each actor held regarding a given situation (Bhaskar 1998). This is not to suggest that stated beliefs are objectively correct since the actors may not have a complete and undistorted view of reality (Mingers 2006) or a clear understanding of their own beliefs. The differences between the expected and actual outcomes may be useful to highlight the degree to which these beliefs may be out of phase with the real nature of the structures in which the actions occur.

Retroduction is largely a creative process for the researcher in which multiple explanations are proposed which describe a causal mechanism, set within a social structure, that must exist in order to produce the observed events. In essence, the researcher conducts what Weick (1989) described as *thought trials* to identify and describe the elements of the causal mechanism and the contextual influences responsible for its activation. Given that mechanisms are rarely, if ever, experienced directly, the retroduced mechanism presents a logical argument explaining how the phenomenon of interest came to be through the emergent properties of the structure interacting within the study context. In other words, we seek to answer the question, "*What properties must exist for [the phenomenon of interest] to exist and to be what [it] is?* Or…more briefly: What makes [the phenomenon of interest] possible?" (Danermark et al. 2002, p. 97).

Specific guidance for retroducing mechanisms is problematic at best given the inherently creative and intuitive nature of the process. The full range of analytical techniques described by various researchers for generating theory from case study research (e.g., Eisenhardt 1989; George and Bennett 2005; Glaser and Strauss 1967; Lee 1989; Miles and Huberman 1994; Pettigrew 1990; Strauss and Corbin 1990; Yin 2003) can be applied to synthesize the data and to draw logical inferences identifying and describing the causes of the observed events (i.e., retroduce the mechanisms). Retroduction is likely to occur in an iterative manner during data collection and analysis involving corroborating interviews, high-order coding, within and cross-case analyses, process tracing, and process modeling. It is also likely to identify many potential mechanisms, at different levels, interacting in different ways to produce events being analyzed. The objective is to identify the most complete and logically compelling explanation of the observed events given the specific conditions of the contextual environment.

As an example of retroduction, Bygstad (2010) identifies *macro-micro* and *micro-macro* mechanisms to explain "how the information infrastructure is generating innovation, and also how the innovations are modifying the information infrastructure" (p. 164). Several of the interview subjects pointed to the "space of possibilities" (p. 164), or the potential combination of components of the infrastructure used to create new services. In turn, these new services extend the infrastructure and space of possibilities, enabling additional combinations at a later point. This was identified by Bygstad as an *innovation reinforcement* mechanism emerging from the information infrastructure. In addition, Bygstad built upon existing theory in the form of Grindley's (1995) standards reinforcement mechanism to identify a service reinforcement mechanism, which posits that the credibility and adoption of a standard increases as it is used to generate increasing value for adoptees. Together, these two self-reinforcing mechanisms enable both the growth of the information infrastructure and the resulting innovation of new services. In addition, Bygstad pointed out the possibility that alternative explanations may exist, such as a market mechanism or entrepreneurial drive. This example highlights two possible methods for identifying mechanisms. In the former, a mechanism was retroduced from the data collected in this particular case. In

the latter, Bygstad adapted an existing mechanism to explain the empirical data.

Empirical Corroboration

Following the identification of alternative theoretical explanations in the form of causal mechanisms, we attempt to corroborate them with the empirical evidence available in the case. The principle of empirical corroboration seeks to use data from observations and experiences to ensure that the proposed mechanisms adequately represent reality, and have both sufficient causal depth and better explanatory power than alternative explanations for the focal phenomenon. It is derived from the ontological assumptions of an independent reality and a stratified ontology, and the epistemology of unobservability of mechanisms and multiple potential explanations. Specific criteria to evaluate proposed causal explanations are discussed below. Further, as part of empirical corroboration, we enhance our descriptions and understanding of the specific contextual conditions under which these mechanisms were enacted.

Corroboration is needed to overcome the tentativeness of inferences derived through retroduction by attempting to validate the existence of the proposed mechanisms. In CR, the hypothesized mechanisms are not only identified as a potential rationale linking cause to effect. We also attempt to verify that these mechanisms were sufficient to have produced the observed effects and that there is reason to believe that the retroduced mechanism was present (and possibly enacted) in the generation of the given phenomena.

The descriptions of causal mechanisms identified through retroduction are transitive hypotheses about the domain of the real, which is comprised of those things that may not be directly observable but that must exist to explain observed events. We are likely to be confronted with a number of alternative causal explanations which potentially could explain the focal events. "[It] is the job of substantive science to discover which [mechanisms] actually do [exist]" (Bhaskar 1975, p. 146). Validation of these knowledge claims includes the empirical search for either the mechanism itself or its effects. Thus, we seek to use data from our empirical observations to assess the proposed causal explanations from two perspectives: first, confirming that the proposed mechanism is clearly and accurately described in terms of generating outcomes within the given context; and second, that it offers better explanatory power than other potential mechanisms that have been identified. Bhaskar describes this as the process "in which the reality of mechanisms postulated are subjected to empirical scrutiny" (1975, p. 15).

Empirically, CR researchers seek to corroborate the extent to which the causal explanations hold within the context studied (Sayer 1992) by using the full spectrum of data describing the social structures, conditions, agency, and events. Corroboration will be impacted by value-aware perceptions of researchers and participants operating within various social structures and the influences of existing theoretical lenses. The application of accepted analytical methods, compelling logic, creativity, and intuition to the empirical data generates confidence that the hypothesized theoretical mechanisms approximate the powers and tendencies derived from the real (social) structures. This may involve assessing the activation and operation of the causal mechanism from the perspectives of multiple participants involved in the observed events. Researchers may also evaluate the extent to which the proposed causal explanation holds across multiple cases and events.

The concept of summative validity (Lee and Hubona 2009), which shares much with the process of pattern matching (Yin 2003), offers support for empirical corroboration.[6] The essential idea is that a proposed mechanism "must survive an empirical test…where survival is indicated by the observation of evidence consistent with what the theory predicts" (Lee and Hubona 2009, p. 246). While CR seeks to explain rather than predict open-system outcomes, the underlying need for validation, through the comparison of the theory's "observational consequences with observed evidence" (Lee and Hubona 2009, p. 246) remains.[7] One means of providing this validation is to identify other events that should have occurred, related to a focal event, if the proposed mechanism existed and was activated. One may use existing data or seek out new data within the current case context to corroborate the anticipated effects of the proposed mechanism. To the extent that study data confirms the related events, the proposed causal mechanisms are corroborated. It may also be appropriate to evaluate the explanatory potential of the proposed mechanism based on how actors' perspectives change over time by testing and refining the description of the mechanism based on longitudinal data.

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[6]We appreciate the suggestion of an anonymous reviewer highlighting the relevance of summative validity and pattern matching to our description of empirical corroboration.

[7]Lee and Hubona specify an empirical test based on the logic of *modus tollens* (i.e., seeking evidence that a prediction is not true to falsify a theory) to establish summative validity. Within critical realism, a single incident of a finding contrary to expectations would not necessarily be the basis for falsifying a proposed causal mechanism. While this may be the case, contrary findings would possibly lead to further explication of events, structure and context, as well as additional retroduction to identify a mechanism acting to counter or nullify the proposed explanation.

Table 3. Evaluating Causal Explanations (derived from Runde 1998)

Causal Test Question	Implications
Are the causal factors of the phenomenon actually manifest in the context?	• Confirm that a cited causal factor was in fact part of the context of the phenomenon. • Confirm that explanatory information from generalization (e.g., reference theory) applies to the specific context. • Ensure causal factors are not idealizations; the causal factor may potentially exist in the realm of the real and not just as an impossible theoretical entity.
If the causal factors were part of the context, were those factors causally effective?	• Assess the proposed causal factor to determine if it is a cause of the phenomenon and not an accidental or irrelevant feature of a genuine cause. • Determine if the proposed causal factor was in fact preceded by another causal factor of the event.
Do the causal factors provide a satisfactory explanation to the intended audience?	• Ensure the causal explanation is not too remote (unspecified links in causal chain or adequate knowledge of links cannot be assumed). • Ensure the causal explanation is not too small such that it is just one of a composite of causes producing the observed event.
Does the proposed mechanism provide causal depth?	• Assess *depth of necessity* such that the observed event would have occurred in the absence of the proposed causal factor due to the presence of an alternative causal factor. • Assess *depth of priority* to determine if the proposed causal factor is closely preceded by another causal factor significant in explaining the event.

This last point emphasizes the value of longitudinal research within the CR paradigm. Understanding changes over time is often instrumental to unwinding the emergent properties of various structures, capturing the full range of contextual influences involved in activating the causal mechanisms, and explicating how and why the mechanisms bring about the observed events. Thus, methodologically we can use the temporal unfolding of events and longitudinal data to corroborate the proposed mechanisms by developing confidence that we have captured the essence of the mechanism and its efficacy relative to alternative explanations.

In order to generate confidence that hypothesized mechanisms approximate reality, we apply rigorous empirical scrutiny. The description of a mechanism is a statement of causes for some empirically identified event. Runde (1998) offers guidance, derived from a realist orientation, to evaluate proposed causal explanations in the form of four key questions (presented in Table 3). Other criteria could be used to guide empirical corroboration (e.g., Healy and Perry 2000; Maxwell 1996). By explicitly answering these questions to assess the mechanisms identified through retroduction, we can generate confidence that the proposed mechanisms provide adequate causal explanations of empirically observed events, and address the full context of the generative structures underlying the mechanisms.

In his study of innovation in information infrastructures, Bygstad (2010) explicitly describes analytic strategies to corroborate the proposed innovation mechanism. The analysis incorporated a process of forward and backward chaining to demonstrate the causation across architecture levels. The innovation mechanism derived in retroduction was evaluated against additional case data, and earlier events that had occurred. Bygstad also "analyzed [the proposed mechanism] in relation to the other assumed mechanism in the infrastructure" (p. 161). Research participants reviewed and provided feedback on causal analysis. Finally, Bygstad briefly discussed the comparative analysis of candidate mechanisms as an attempt to highlight those which "offer the strongest explanatory power" (p. 166) relative to the case data. As a result, this allowed alternative potential mechanisms such as the market mechanism and entrepreneurial drive to be ruled out as sources of service innovation.

Morton (2006) and Volkoff et al. (2007) used similar strategies consistent with the idea of summative validity to empirically corroborate the hypothesized mechanisms. Both studies identified and confirmed related events that would have been expected to occur had the mechanisms been activated. Morton (2006) identified three separate events generated by the proposed integration mechanism which promoted the interconnection of disparate systems. In a study exploring how the implementation of an enterprise IS leads to organizational change, Volkoff et al. (2007) explained why the embeddedness mechanism generated different outcomes (e.g., changes to routines, roles, and data) at different plant locations and during different project phases.

Triangulation/Multimethods

The principle of triangulation and multimethods reflects the importance of including multiple approaches to support causal analysis based on a variety of data types and sources, analytical methods, and theoretical perspectives. CR posits both the existence of an independent reality that can only be fallibly accessed by humans, and the ability of science to approach this reality in a hopefully progressive manner. In accordance with the epistemological principles of mediated knowledge, unobservability, and the possibility of multiple mechanisms, we as researchers should endeavor to approach the underlying reality from multiple viewpoints in order to overcome our perceptual limitations.

The purposes of triangulation/multimethods are twofold. First, critical realism acknowledges that reality is composed of many types of structures (e.g., physical, social, conceptual, motivational, etc.), each with different emergent properties, powers, and tendencies. Different structures call for different means of developing knowledge about them and their properties which requires the use of different methods and perspectives.[8] The second purpose is to control for the influence of various biases on the research process and the results generated by the process.

Triangulation/multimethods can be accomplished by using various combinations of data sources, theories, investigators, and methods in the conduct of a program of research (Denzin 1978). Data triangulation involves collecting data from varying sources (e.g., interviews, archival data, documentation, observation, or physical artifacts) (Yin 2003) in order to facilitate the development of potential explanations regarding each event. The issue is not one of repeated confirmations of event, structure, or context specifics, but the potential to abstract to a clearer understanding of the causal factors and relationships. Theoretical triangulation includes the investigation of empirical data using alternative theoretical perspectives, thus enabling the researcher to explore rival explanations. Employing multiple investigators reduces any personal biases emanating from the researcher(s) that may otherwise influence the interpretations applied to a given set of data (Denzin 1978).

For case study research, a key concern is methodological triangulation, which implies the concurrent, but separate collection and analysis of "different but complementary data on the same topic" (Morse 1991, p. 122). The general purpose is to capitalize on the strengths of each method while compensating for the various weaknesses. In so doing, the researcher avoids examining the phenomenon through a limited viewpoint, instead opting for wider perspective (Mingers 2004b). Although typically used to mean a combination of qualitative and quantitative methods, in CR methodological triangulation also includes the integration of multiple qualitative or multiple quantitative methods that help to expose the causal factors we seek.

Methods can be integrated in several ways, including the timing, relative importance, and mixture of each method in a given study (Creswell and Plano Clark 2007). However, the ability to combine multiple methods can be problematic due to cultural, psychological feasibility, and practical reasons (Mingers 2001). The extent of triangulation seeks to balance the potential for enhanced understanding of causality with the challenges of increased complexity.

Existing case studies vary widely in the degree to which this principle is applied. Bygstad (2010) relied on four types of data in the conduct of the case study: interview data, direct observation, archival documentation, and participation as a frequent customer of the target company's services. Volkoff et al. (2007) utilized data from interviews, participant observations, and informal conversations from informants at different organization levels, functional areas, and locations. Additionally, investigator triangulation was addressed by actively involving all three authors in data collection and analysis. A more detailed example of multimethod research in CR can be found in Zachariadis et al. (2010), which integrates a series of studies based on interview data, econometric analysis, survey data, and historical analysis to investigate the economic benefits of IS innovation in the banking industry. According to Zachariadis et al., "data collection and analysis from each method provided feedback and context to the results generated from other approaches in a way that mutually informed each other" (p. 11). The linkages between the various methods utilized in each subsequent study enabled Zachariadis et al. to obtain a deeper understanding of the phenomenon under investigation.

CR Specific Aspects of Case Studies

We have identified five core methodological principles drawn from the ontological and epistemological assumptions of the philosophy of critical realism. We have also established the case study as the primary research design in this paradigm. The extant literature provides substantial guidance regarding the conduct of case studies generally (e.g., Yin 2003), from a positivist perspective (Dubé and Paré 2003; Eisenhardt 1989;

[8]We appreciate the input of an anonymous reviewer in clarifying this motivation for multimethods in CR.

Lee 1989), and the interpretivist perspective (Walsham 1995, 2006). Much can be gained from these various approaches when conducting a CR case study. However, three aspects of case study research have particular manifestations in CR: specifying the research question, case selection, and generalizability. The consistent thread for all in CR is an explicit focus on establishing causality. Because we seek to explain how and why specific, complex events occur in a particular context, instead of merely describing the events in theoretical terms, testing existing theories or proposing a model for prediction, these aspects of case research require special consideration.

The first aspect of case study research with unique considerations in CR deals with establishing the research questions. Given the epistemological principles of CR, "the [research] question must be of the form 'What caused the events associated with the phenomenon to occur?'" (Easton 2010, p. 123). By asking about the causes of *specific* events, we are targeting the how and why questions associated with explanatory case research (Yin 2003). Causal research questions establish a focus on the search for mechanisms in a particular context. For example, Bygstad (2010, p. 157) identifies the research question as "how can an information infrastructure provide generative mechanisms for innovation?" In other words, the question seeks the mechanisms responsible for the key events which best illustrate the firm's innovativeness. Morton (2006) is more direct in stating the research question as "what are the causes of the outcomes of attempts to develop and implement strategic IS plans in organizations?" (p. 7). In both studies, the specifics of the research question provided the framing for the study design and execution.

In order to explain a specific phenomenon, associated events must have already occurred. Thus the orientation of the research is, by necessity, retrospective. The research questions provide the basis to identify the relevant events for the phenomenon of interest and the framing of an appropriate context. This can include the investigation of an on-going phenomenon guided by present tense research questions, such as questions exploring various human or organizational impacts associated with the implementation of a complex information system. Causal research questions in CR drive the adoption of explanatory case designs utilizing a variety of data sources and analytical methods with the potential to expose specific causal factors inherent to a particular structure, group of actors, and setting, and that are capable of bringing about the phenomena of interest.

The second aspect of case study research deals with case selection. IS case study research is frequently concerned with explaining how a particular set of circumstances evolved in a specific case or a limited number of cases (Ackroyd 2009). Such intensive or idiographic case studies (Sayer 1992) examine distinct events within the context of a specific setting, with each event being investigated individually and temporally to identify the effects of environment, context, structure, and individual influences.

The distinguishing aspect of intensive case selection in CR is the focus on exposing the causal processes, expressed as causal mechanisms, which have produced a *unique* set of events and the *specific* structural/contextual factors that combined to generate them. As such, the results are not typically or necessarily generalizable across multiple contexts so that case selection is not made on this basis. The emphasis is on the detailed and precisely focused study of a limited number of cases, often a single case, in a specific setting in an attempt to build an explanatory theory that matches the empirical facts as closely as possible (Sayer 1992; Tsoukas 1989). This intensive study of a particular setting often results in an in-depth, contextually relevant analysis of a complex organizational process (Bengtsson et al. 1997). In so doing, these studies are effective for providing concrete explanatory details regarding a limited number of events. As a result, such idiographic case studies are the dominant approach to CR research because this methodology enables researchers to develop detailed context-sensitive causal explanations of specific phenomena.

Typically, case study research focuses on an intensive examination of events occurring in a single structure, such as a single company (Bygstad 2010), or a composite structure, such as multiple divisions (Morton 2006) or sites (Volkoff et al. 2007) within a firm. The selection of a case usually reflects the existence of events which are representative of the phenomena a researcher is attempting to explain.

Finally, generalizability has a particular significance in critical realism and requires further elaboration relative to case study research. The concern is not of generalizing findings through statistical inference from a particular sample to a broader sample population. Given the highly complex phenomena that are the focus of IS research, we cannot expect identical or even highly similar outcomes if we were to replicate a given study in a different organizational, industry, regional, or cultural setting. Rather the intent under CR is to utilize the detailed causal explanations of the mechanisms at work in a given setting to obtain insights as to how and why a similar mechanism could lead to different, or perhaps similar, outcomes in a different setting (Becker 1990). We seek to explain any such differences not as *exceptions* to theory or as occasions to invalidate the original causal analy-

sis, but rather as an integral element of any proposed explanation or theory. Thus, generalizability provides a means to leverage existing statements of causal mechanisms to explain events observed within the specific context of the new setting as opposed to predicting outcomes based on the generalization of theory to a new population or context. This serves to validate the explications of causal tendencies and the interplay of mechanisms and context, and refine our theories. In essence, the generalization within CR-based case study research is generalization to theory (Lee and Baskerville 2003; Yin 2003).

Unfortunately, this is often misrepresented in published works by researchers more accustomed to considering generalizability in statistical terms. For example, Bygstad (2010, p. 167) suggests that the innovation mechanism should be studied in "similar or other types of information infrastructures, both to test the validity of the suggested mechanisms and to discover others." Volkoff et al. (2007) also commented on the need to validate the embeddedness mechanism for other types of enterprise systems and in other organizational settings. While replication is useful for teasing out the impact of additional contextual and structural factors on the candidate mechanisms, it is not necessarily sufficient to falsify a proposed mechanism or enhance its validity.

Discussion and Conclusions

Critical realism is rapidly emerging as a viable paradigmatic alternative for conducting social science research that is well suited for developing causal explanations of complex phenomenon. Although CR is potentially applicable to a wide range of methodologies, we have focused on case study research as it is particularly well-suited for CR-based efforts to develop explicit causal explanations of the complex social, organizational, and interorganizational phenomena encompassing the IS field. To address this focus, we have developed a set of five methodological principles to guide the conduct and evaluation of critical realist case study research. As a result, this paper makes three primary contributions in an attempt to address gaps in the existing IS literature.

First, we have rendered the philosophical literature on CR more consumable. We have synthesized the very deep, complex, and diverse literature describing the critical realism philosophy to identify and explicate its core ontological and epistemological principles. As espoused by Bhaskar (1975, 1998), critical realism represents a fundamentally new philosophical approach to conducting social science research. Our presentation of the fundamental concepts of CR opens the door to this alternative in a straightforward way for those not steeped in the specifics of the broader philosophy of science literature or Bhaskar's presentations of critical realism. Researchers can use this work to make clear delineations between the core ideas of CR and the other dominant approaches to research in IS.

Next, this research opens the door to explicit and direct focus on causality in IS research. We used the ontological and epistemological principles upon which CR is based to demonstrate the unique potential of this approach to ascribe causality in open-system contexts through the identification and explication of generative mechanisms. By identifying and describing mechanisms, at multiple levels of analysis, which emerge from physical and social structures as well as key participants, we can establish explicit causal knowledge. IS researchers are frequently challenged to justify and explain why, theoretically, study findings deviate from expected results. Adopting CR-based case study research that leverages the five methodological principles establishes the path for researchers to create generalizable theories explaining precisely why an IS phenomenon occurred in a particular setting.

Third, we used the core assumptions of critical realism to develop a set of integrated methodological principles to support the conduct and evaluation of CR-based case study research. The principles capture the essence of what is needed in research adopting this philosophy. This does not outline specific procedural requirements to be followed in rote. Researchers need to address explication of events and structure, retroduction, empirical corroboration, and multi-methods in CR research. The specific methods by which each is tackled will vary based on the circumstances of each project and the objectives of the research. But with these methodological principles, researchers have clear guidance on what is required. These principles establish explicit criteria for researchers and reviewers to assess the quality of CR-based research.

We believe that critical realism will continue to gain acceptance in IS research, leading to several opportunities for subsequent researchers to extend the proposed methodological principles. The first such opportunity to broaden the application of critical realist based research is to employ the emancipatory axiology of CR in critical theory studies. Bhaskar's more recent works (1993, 1994, 2000) deal with the potential of social science research to unleash human freedoms. In essence, humans and their actions are constrained by the social structures and mechanisms in society (Mingers 2009). As such, CR provides a way for researchers to critique the existence and ethical value of these social

structures (Hartwig 2007). To the extent that information systems are components of these structures and mechanisms, CR-based case study research that explicates these relationships and how the human condition is adversely impacted affords the potential to inform corrective action based on the knowledge of the causal mechanisms involved. The proposed methodological principles fully support research with an emancipatory focus. An opportunity exists to leverage recent work on critical theory research (Myers and Klein 2011) to refine these CR principles and to create new ones, applied to case studies or other research methodologies, to enhance the conduct and evaluation of emancipatory IS research.

The second opportunity to extend this research is to refine, add to, and, where appropriate, replace the proposed principles. As new methodologies are developed based on the premises of critical realism, the appropriate set of guiding principles may change. While CR as a philosophy supports a variety of methodologies, our focus and the preponderance of empirical work has been on intensive case study research. IS researchers have applied the concepts in extensive case studies (de Vaujany 2008). Likewise, the potential to introduce critical realist quantitative methods, and combine these with qualitative methods in a truly multimethod approach, is largely unexplored empirically. As these new approaches are explored, many of the proposed principles will still apply but some may need to be revised, some eliminated, and new principles developed.

A key focus and primary motivation for this research is to bring greater attention to the critical realism paradigm by offering guidance to make it more practicable. Adopting the proposed principles in conducting CR-based case study research offers potentially significant benefits for IS researchers. Critical realism provides a compelling third way, sitting between the poles of positivism and interpretivism (Reed 2009), leveraging elements and strengths of both while allowing researchers to generate *usable* theories that provide detailed causal *explanations* of complex, open system phenomenon (Lyytinen and Newman 2008; Markus and Silver 2008). It overcomes perceived ontological and epistemological inconsistencies in the more prevalent paradigms with the potential to improve the depth and utility of research findings (Smith 2006).

In the IS realm, CR theories of mechanisms are derived from the relevant empirical details of a particular setting. Grounding an IS phenomenon in this way in order to generate explicit causal explanations is the basis through which researchers may address perceived "knowledge gaps" between academia and practitioners (Van de Ven 2007) and begin to attend to practitioner desires for more prescriptive solutions (Straub and Ang 2008). Thus CR-based case study research offers one means to increase the value of research to praxis.

CR-based case study research provides researchers with an opportunity to realize the essence of theorizing by providing deep explanations (Grover et al. 2008). We hope that these methodological principles encourage greater understanding and acceptance of the CR paradigm. Furthermore, we hope they encourage researchers to employ CR-based case studies, and other CR research designs, to enhance our understanding and explanations of information systems phenomenon in organizations.

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Appendix A

The more philosophically oriented literature on critical realism offers a number of models for developing causal explanations. Bhaskar (1975, 1986) presented two models to address the differing needs of natural and social science. Danermark, et al. (2002) integrated and extended Bhaskar's models while Mingers (2006) discusses a similar approach focused on intervention or bringing about necessary or desired changes. Our proposed methodological principles are entirely consistent with these various models. We provide a brief overview of Bhaskar's models, as these are the foundation for the others, and summarize the various models in Table A1.

Bhaskar (1975) outlined a four-stage process for developing causal explanations of complex events in open system contexts. First, the event is resolved into its component parts that may have had some causal effect on the outcome. This essentially describes the boundaries and key aspects or components of the situation. Next, these components are redescribed in terms of existing theory, if possible and appropriate to support a particular theoretical orientation, in order to specify how the causes were involved in an explanation of the event in question. We then utilize retroductive reasoning to identify the possible causal mechanisms which could have produced the redescribed components. Finally, independent evidence and empirical analysis are used to eliminate alternative causes until the one that actually caused the event is identified. This process has been called the RRREI model of explanation, based on an acronym of the primary stages: resolution, redescription, retroduction, and elimination/identification.

Table A1. Models of Explanation in CR

CR-Derived Principles	Bhaskar (1978)	Danermark et al. (2002)	Mingers (2006)
Explication of events	Resolution, Redescription	Description	
Explication of Structure and Context	Resolution, Redescription	Analytic Resolution; Abduction/Theoretical Redescription	Appreciation
Retroduction	Retroduction	Retroduction	Analysis
Empirical Corroboration	Elimination & Elaboration	Comparison; Conceretization	Assessment
Triangulation & Multimethods	—	—	—

For the explanation of theoretical phenomena typically associated with the natural sciences (i.e., ideally controlled experiments in closed systems), Bhaskar (1986) defines a different process called DREI: description of law-like behavior, retroduction using analogies to possible explanations of behavior, elimination of alternative explanations, and empirically controlled identification of the causal mechanisms at work. DREI differs from RRREI in that the latter presupposes the existence of a set of theoretical concepts or hypothesized mechanisms that have been identified and tested under closed or controlled conditions (i.e., under DREI-schema explanations) (Collier 1994). It is possible that such concepts do not exist as no such closed conditions are likely, especially in the social sciences, thus suggesting the need to use description and retroduction in place of redescription and retrodiction in such open system contexts (Collier 1994; Steinmetz 1998).